Japanese Patent Application Laid-open No. Sho 61-239696

Specification

1. Title of the Invention Component Feeding Apparatus

2. Range of Claim for Patent

1. A component feeding apparatus including a feeding table unit loaded with several types of electronic components which is reciprocated laterally on a base, and stopped at a predetermined position for feeding the components continuously to a transfer mechanism, wherein the feeding table unit is divided into a plurality of tables each moved individually on a single straight line by a drive means, said drive means moving and positioning the divided tables separately to a predetermined position in opposed relationship with the transfer mechanism in response to a command from a control unit.

2. A component feeding apparatus of claim 1, wherein said drive means is made up of a linear motor including a stationary part having a couple of magnets arranged along a straight line in spaced relationship with each other and a moving part having a coil protruded downward from one of the divided tables and inserted in the space between the magnets.

3. A component feeding apparatus of claim 2, wherein said magnets are arranged closely in proximity to the transfer mechanism and with greater intervals at other positions,

or magnets having high coercive force are arranged closely to said transfer mechanism and magnets having low coercive force are arranged at other positions.

4. A component feeding apparatus of claim 1, wherein said drive means for moving and positioning the divided tables includes a control unit, an optical or magnetic linear scale of high resolution in the vicinity of the transfer mechanism and a proximity switch or a low resolution linear scale at the other positions.

5. A component feeding apparatus of claim 4, wherein the control unit includes a system controller, a plurality of drive circuits, linear scale detection circuits, drivers and servo controllers fewer in number than the divided tables, said proximity switch or said low resolution linear scale detecting a divided table approaching the region covered by the high resolution linear scale thereby to switch the connections of the drive circuits and the linear scale detection circuits to the divided tables.

6. A component feeding apparatus of claim 1, wherein each divided table includes a component storage unit installed thereon for sequentially delivering the components, thereby forming a component mounting machine including the transfer mechanism for picking or holding the components on the divided tables and conveying the components to the board and a X-Y table having the board disposed thereon for placing the board at a predetermined position two-dimensionally.

3. Detailed Description of the Invention

[Technical Field of the Invention]

The present invention relates to a component feeding apparatus for mounting a multiplicity of types of small components in a predetermined position on a board at high speed, and more in particularly to a component feeding apparatus for a component mounting machine for mounting a multiplicity of types of electronic components stored in a tape reel on a printed board at high speed.

[Background Technology]

A conventional electronic components mounting machine or apparatus for mounting a multiplicity of types of electronic components on a printed board, as disclosed in the Japanese Patent Application Laid-open No. sho 55-118698, is so constructed that an electronic component supply unit is disposed on a component feeding table which is laterally reciprocated and adapted to stop at a predetermined position, and the components feeding table is moved each time a transfer head absorbs an electronic component from the feeding unit. A plan view of this mechanism is shown in FIG. 6. The electronic component mounting mechanism comprises a body base 1, a components feeding table 2, a rotary head 3 as a transfer mechanism, and an X-Y table 4. A drive mechanism for the components feeding table 2 includes, as shown in FIG. 7 which is a sectional view along line VII-VII of FIG. 6, a linear guide 5 with the components feeding table 2 placed thereon, a rack 7, a pinion 8, a reduction gear 9, and a motor 10 for driving the components feeding table 2 through the reduction gear 9 by the rack 7 and pinion 8. Another type of drive

mechanism includes a DC motor or stepping motor for driving a ball screw.

Scores to almost a hundred types of tape reel units accommodating electronic components therein are disposed in parallel to each other on the components feeding table 2. This table 2 is positioned at high speed to place any tape reel accommodating the required electronic components just under an absorption point 3a of the rotary head 3. In synchronism with the absorption of an electronic component and rotation by the rotary head 3, the X-Y table is positioned so that a predetermined point coated with an adhesive of the printed board may come just under the transfer point 3b of the rotary head 3. Then, the electronic component is transferred to the printed board. These steps of operation are performed continuously at high speed.

In this conventional apparatus, the whole apparatus is stopped to supplement the components whenever the electronic components are depleted on the table. For this type of apparatus which transfers as many as several components per second at high speed, this suspension of operation for set-up causes a considerable reduction in the working efficiency.

To the extent that the components handled are about 20 to 40 types, the movable units weight not more than several tens of kg and the motor capacity not more than 1 KW, it is possible to use a controller with a small capacity in this conventional apparatus. However, with an increase in the transfer speed of up to 0.3 to 0.4 seconds per component, and with an increase in the types of components handled to as many as one thousand, with a corresponding increase in the movable units weight to at least 100 kg, the resultant necessary increase in the capacity of the motor and controller makes this apparatus uneconomical. Further, if driven by a ball screw, such an apparatus requires a ball screw

as long as several meters, thereby rendering a high-speed drive very difficult in technical aspects of control and vibration.

Furthermore, a heavy item weighing more than 100 kg and moving at high speed generates a great vibration and noise, resulting in various problems of a reduced mounting performance and a reduced strength of component members for a high-precision mounting apparatus.

[Object of the Invention]

The object of the present invention is to permit the work of supplementing electronic components without suspending the drive of the table engaged in transfer of electronic components.

[Summary of the Invention]

In order to achieve the above-mentioned object, there is provided according to the present invention a component feeding apparatus comprising a plurality of component feeding tables divided, a drive mechanism including a linear motor, a transfer mechanism, and means for placing the feeding tables in opposed relationship with the transfer mechanism in a predetermined position, the feeding tables being drivable severally along the same straight path.

In view of the fact that there are provided a plurality of component feeding tables each drivable and stoppable severally on the same straight path as described above, each divided table weigh less, only a table engaged in the transfer of an electronic component is capable of high-speed positioning at high precision, and while the electronic component is being transferred to a board, the remaining tables are kept stationary on both sides of the

base, thereby making it possible to supplement parts on the stationary tables during the operation of the apparatus.

[Description of the Invention]

An embodiment of the invention will be described using an electronic component feeding apparatus based on the drawings.

FIG. 1 is a plan view of an electronic component feeding apparatus, and FIG. 2 is an enlarged cross-sectional view along line II - II of FIG. 1.

A body base 11, having a length predetermined for allowing the component feeding table to run thereon, includes rail-like linear guides 12 protruded on both sides on the upper surface, and a slot 14 extending substantially over the whole length of the body base for mounting the linear motor 13 at the central part thereof. The component feeding table running on the body base 11 requires a length of about several meters in total if about 100 types of electronic components are to be supplied. The component feeding table is formed of divided tables 15 (15a, 15b, 15c, 15d and 15e). With running members 16 provided on both sides of a lower wall and engaged with the linear guides 12, each table 15 is adapted to run separately on the linear guides 12. The linear motor 13 making up a running (drive) unit includes magnets 17 arranged in opposed relation to the motor on both sides of the slot 14 of the body base 11 and a magnetic circuit 18 formed between the magnets 17, thereby forming a stationary part. A moving part includes a bobbin 19 wound with a coil 19' protruded on the lower surface of the table 15, and the bobbin 19 is inserted in the space between the magnets in such a manner that the coil 19' cuts the lines of magnetic force 18. Upon energization of the coil 19', the table 15 runs on the linear guides 12 by magnetic

force. The magnets 17 making up the stationary section are arranged over the entire stroke of the body base 11, while the moving parts include a plurality of bobbins 19 of the table 15 arranged on a straight line, sharing the use of the magnets 17 of the stationary section.

Of all the plurality of divided tables 15, only the table opposed to the rotary head 3 as the transfer mechanism, i.e. the table 15b in Fig. 1, is positioned by being driven at high accuracy, while the other tables 15a, 15c, 15d and 15e are moved and stopped on the sides of the body base.

As will be seen from the above explanation, the high-accuracy high-speed positioning operation is required only for the part 20 1 mm long designated by L near the rotary head 3, and therefore the drive mechanism can be simplified as shown in FIG. 3. Specifically, in the areas other than part L designated by 20, the high-accuracy positioning is not required, and therefore the magnets 17b of the magnets are arranged intermittently, so that the drive in the areas is partially obtained from inertia. The position detecting mechanism for the positioning work, on the other hand, includes a high-resolution linear scale 21 only in the area associated with the part L designated by 20, while in the areas other than L, proximity switches 22 are arranged at intervals to detect the position of each divided table 15. Numeral 23 designates a linear scale head disposed in opposed relationship with the linear scale on the divided table side.

A control unit of the embodiment will be explained with reference to FIG. 4.

At least two sets of a driver 24 and a servo controller 25 are provided for a plurality of the linear motors 13a, 13b, 13c, 13d and 13e for a plurality of divided tables 15a to 15e.

A system controller 26 is provided above the servo controller 25. A switch 29 for switching the drive circuit 27 and the position detection circuit 28 is inserted between the driver 24 and each of the linear motors 13a to 13e for the tables. Specifically, the drive circuit 27 is switched to the connection of the coils 19a to 19e of the divided tables, and the position detection circuit 28 is switched to the heads 23 (23a to 23e) of the linear scale.

The functions of the control unit and the resulting operation of the divided tables will be explained with reference to FIGS. 5 (a), (b), (c) and (d) in that order.

FIG. 5(a) shows the case in which the linear motor 13c of the table 15c loaded with the component designated by the system controller 26 is driven by the driver 24 to reach a point just under the transfer head 3 until the deviation of the servo controller 25 becomes zero. In this state, the drive circuit 27 and the position detection circuit 28 are connected by the switch 29, and the linear scale 21 is used for positioning as the high-precision positioning operation is involved. The linear motors 13a, 13b, 13d and 13e for the other tables 15a, 15b, 15d and 15e are kept at the ends of the body base, and the drive circuit 27 and the position detection circuit 28 thereof are not connected with those nor is the driver 24' used. Upon issuance of a command for using the component placed on the table 15d from the system controller 26 at the next moment, the linear motor 13c of the table 15c that has thus far conducted the work of transferring the part is moved to the opposite side of the table 15d in response to the signal from the system controller 26 as shown by FIG. 5(b), and at the same time, the drive circuit 27' of the driver 24' of the switch 29 is connected to the linear motor 13d. As a result, the linear motor 13d begins to move toward the transfer head at the center of the apparatus and when it passes the promixity switch 22' nearest to

the linear scale 21, the command is transmitted to the system controller 26, thereby connecting the position detection circuit 28' by the switch 29 as shown in FIG. 5(c). The linear motor 13c of the table 15c, on the other hand, when it passes the proximity switch 22" or the like on the opposite side of the proximity switch 22' or the like, is disconnected with the position detection circuit 28, and when it comes to a predetermined position, is further disconnected with the driver circuit 27.

Then, as shown in FIG. 5(d), the linear motor 13d of the table 15d is driven by the commands of the system controller 26 and, stopping at the predetermined position, conducts the components transfer work through the transfer head. This state is the same as that of the linear motor 13c shown in FIG. 5(a). However, the driver 24, the drive circuit 27 and the detection circuit 28 are open, so that the circuits 27 and 28 are used for the next switching of the operation of the tables. The switching operation is performed in this way, thereby making it possible to perform the driving and positioning operation with a fewer number of drivers and circuits than the linear motors.

Each table is loaded with 20 to 30 types of small electronic components which are transferred at high speed to the board. Therefore, the switching is operated not to jump to the next table but one or any further table but always to the adjacent table for part transfer work.

Of the plurality of tables, those tables depleted of the electronic component are kept stationary on the sides of the body base, and in this state, the electronic components are supplied to them. Even during this component supplementing work, the electronic components continue to be transferred from the table positioned at the center to the printed

board through the rotary head. In this way, the apparatus performs the components-supplementing work by supplying the electronic component to the component feeding tables (divided tables) while the apparatus is in operation.

It will thus be understood from the foregoing description that according to the present invention there is provided a component feeding apparatus in which of all the plurality of tables, only the table which is engaged in the transfer work of the electronic components through the rotary head is moved to position at high speed while the other tables are kept stationary, and therefore the weight of the moving parts made up of the tables is reduced to less than one fourth of the conventional apparatus, thereby reducing the force, vibration or noise generated in the components of the apparatus for an improved performance and strength.

[Effect of the Invention]

As described above, according to the invention, the component feeding table is divided into a plurality of tables. Divided tables engaged in the transfer of an electronic component is capable of high-speed positioning at high precision, while the remaining tables are kept stationary on both sides of the base, thereby making it possible to supplement components on the stationary divided tables during the operation of the apparatus. Therefore, the transfer work of the electronic components can be improved without suspending the drive of the apparatus due to supplementing of the components. Among the plurality of the divided component feeding tables as a moving part, only the divided table which is engaged in the transfer work of the electronic components is moved to position while the other tables are kept stationary, so that the weight of the moving parts

is reduced to less than one fourth of the conventional apparatus, thereby reducing the capacity of the drive part and the control part.

4. Brief Description of the Drawings

FIG. 1 is a plan view of a component feeding apparatus according to an embodiment of the present invention.

FIG. 2 is an enlarged sectional view taken in line II-II in FIG. 1.

FIG. 3 is a plan view showing the component feeding apparatus in detail.

FIG. 4 is a diagram showing a configuration of a control unit.

FIG. 5 is a diagram for explaining the operation of the control unit, of which the diagrams (a), (b), (c) and (d) illustrate the sequence of operation.

FIG. 6 is a plan view showing a component mounting apparatus comprising a conventional components supply apparatus.

FIG. 7 is an enlarged sectional view taken in line VII-VII in FIG. 6.

3 ... transfer mechanism 11 ... base 13a, 13b, 13c, 13d, 13e ...linear motor 15a, 15b, 15c, 15d, 15e ...divided table 17, 17b ... magnet

19 ... bobbin 19' ... coil 21 ... linear scale 22 ... proximity switch 23 ... linear scale head 24 ... driver 25 ... servo controller 26 ... system controller 27 ... drive circuit 28 ... position detection circuit 29 ... switch